Final Report: Los Alamos Opacity Verification and Validation Workshop

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Los Alamos Opacity Verification and Validation Workshop 2005

The purpose of this workshop is to bring together theorists and experimentalists in the area of plasma opacity and its applications to try to determine to what extent we can verify and validate our opacity calculations. Simply put, by validation we mean, “Are we solving the right equations?” and by verification “Are we solving them correctly?”.

More specifically, to verify an opacity calculation, we want to make sure that the equations that represent the particular opacity theory we have chosen have been implemented on the computer in such a way as to produce the exact solution of those equations to the desired numerical accuracy. Impediments to this goal can include interpolation errors, insufficiently converged atomic Hartree-Fock wave functions and similar numerical problems.

To validate calculated opacity values we want to determine if our theoretical model is sufficient to give results that agree, again with a desired accuracy, with the actual real-world value for the opacity. This is hampered by the fact that most of the density and temperature points for which we calculate opacities are not easily accessible in the laboratory.

Additionally, the term opacity here can refer not only to frequency averaged quantities such as the Rosseland and Planck means, but also to frequency dependent spectra. This would appear to be a daunting task but we are not without hope or means!

To address the verification problem we can take similar calculations performed by different groups and compare them at opacity code comparison workshops. These comparisons have many times pointed out errors in calculations that were not apparent at first. At the upcoming WorkOp at Lawrence Livermore National Lab we will continue these comparisons.

Validating the results of these calculations is the primary subject of the current Workshop here at Los Alamos. We will hear from those who perform laboratory opacity measurements; those who use opacity data to accurately explain stellar structures and behavior; those who use opacity data to model thermonuclear devices; and those who calculate the opacities. From these talks we hope to begin to construct a road map to quantify computed opacity uncertainties.

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